KNIGHT
GLOBAL

Smart Cart
Operation Manual

knight

THIS MANUAL CONTAINS IMPORTANT INFORMATION REGARDING INSTALLATION, SAFETY, MAINTENANCE, AND OPERATION OF THE KNIGHT GLOBAL SERVO CART AND SHOULD BE AVAILABLE TO ALL PERSONNEL. RESPONSIBLE FOR USING THE CART.

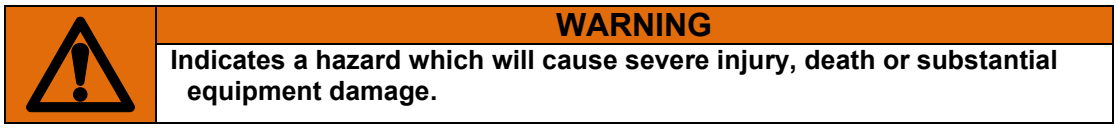
REV: 020-202201

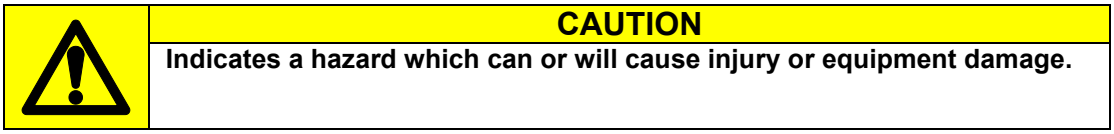
This manual provides important information for all personnel involved in the installation, operation and maintenance of the Knight Global Smart Cart. All personnel must read this document before operating the equipment.

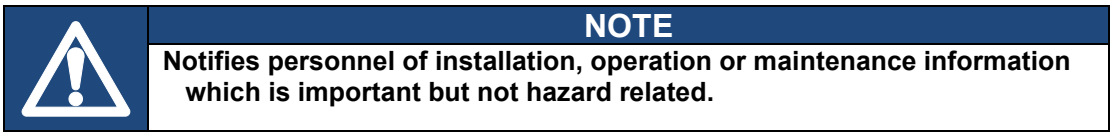
Every effort has been made to provide complete and accurate product information in this manual. However, due to product improvements and changes, discrepancies and omissions may be present. Visit our website at www.knight-ind.com for the updated information on all our products.

It is the responsibility of the end user to exercise common sense and judgment when performing the tasks described in this manual. If any procedure seems inaccurate, incomplete or unsafe please put the equipment in a safe condition and contact Knight Global service department for assistance. Knight service department's phone number is: (248) 375-7962.

Throughout this manual there are steps and procedures that if not performed correctly can result in personal injury or equipment damage. The following signal words are used to identify the level of potential hazard.







1. SAFETY

Knight Global cannot be aware of or provide for all the procedures by which the Smart Cart operations or repairs may be conducted and the hazards which may result from each method. If operation or maintenance not specifically recommended by Knight Global is conducted, it must be ensured that product or personnel safety is not endangered by these actions. If not sure of an operation or maintenance procedure or step, personnel should place the Smart Cart in a safe condition and contact a supervisor and/or Knight Global's service department for technical support. Modifications to upgrade, re-rate or otherwise alter this equipment shall be authorized only by the original equipment manufacturer.

If a below-the-hook lifting device or sling is used with the Smart Cart, refer to ANSI/ASME B30.9 "Safety Standard for Slings", or ANSI/ASME B30.20 "Safety Standard for Below-the-Hook Lifting Devices".

Electrical equipment described in this manual are designed and built-in compliance with ANSI/NFPA 70, "National Electrical Code". It is the responsibility of the system designer, system manufacturer, crane or rail manufacturer, installer, and user to ensure that the installation and associated wiring of the Smart Cart and components are in compliance with ANSI/NFPA 70, and all applicable Federal, State and Local Codes.

Hazardous voltages are present in the Smart Cart and components. Only properly trained and competent personnel should perform inspections or repairs on the Smart Cart or accessories. Prior to performing any maintenance (mechanical or electrical) on the Smart Cart, de-energize (disconnect) the main switch supplying power to the Smart Cart. Lock out the power supply following standard plant procedures.

Ensure that the installation, inspection, testing, maintenance and operation are in compliance with ANSI/ASME B30.16 "Safety Standard for Overhead Carts", OSHA Regulations, ANSI/NFPA 70, National Electric Code, and applicable ANSI/ASME standards. This is the responsibility of the owner/operator.

All personnel that will install, operate, inspect, test or maintain the cart should read this manual and be familiar with all applicable portions of the referenced standards.

If clarification of any information in this manual or additional information is required, contact Knight Global. Do not install, operate, inspect, test or maintain the cart unless all information is understood.

A. General Safety Precautions

NOTE
Read all technical manuals/directions provided with the product before attempting to operate or perform service/maintenance on any part of the system.

Although the procedures covered in this manual have proven to be safe in use, Knight Global assumes no responsibility for personal injury or damage to the equipment resulting from their application.

WARNING
It is not possible to cover all safety conditions in this manual. Therefore, always be alert and work safely.

Basic Safety Procedures

Although the procedures covered in this manual have proven to be safe in use, Knight Global assumes no responsibility for personal injury or damage to the equipment resulting from their application. It is not possible to cover all safety conditions in this manual. Therefore, always be alert and work safely.

- Follow all applicable Federal, State, Local or Company policies or regulations
- Do not overload the Smart Cart, this could damage the cart.
- Do not let loads significantly over hang the sides of the platform; this could cause the Smart Cart to tip over.
- Lock the wheels when leaving the cart unattended.
- Do not move the Smart Cart with the load in the uppermost position.
- Do not use the Smart Cart if any damage is evident.

Lithium-Ion Battery and Charging Safety Precautions:

- Do not short circuit the battery.
- Do not drop, throw or crush the battery.
- Keep battery away from heat sources, high voltage, and other high-temperature sources.
- Never smoke or allow an open flame in the vicinity of the battery.
- Do not leave the battery exposed to sunlight for extended periods of time.
- Do not attempt to dissemble the battery.
- Do not connect to the battery in reverse polarity.
- Do not use charger with a two bladed adapter plug or extension cord. Doing so can result in serious personal injury.

B. Safety Devices

Motor Holding Brake

A motor holding braking system engages and holds the vertical axis in place when power is removed from the cart or in the event of a power outage. The motor holding break is also engaged when there the chain is not moving.

Overload Capacity Protection

Protects the equipment and prevents the operator from lifting or moving more weight than the system is rated for. If the load weight causes the cart to draw more amps then the programmed current limit, the cart will not lift any further until the excess load is removed. Downward motion is permitted when overloaded to allow the user to safely set the weight back down on a stable surface.

Safety Drop Stop (SDS) Chain

All Standard units have a Safety Drop Stop (SDS) chain included. The SDS Chain moves up and down the vertical axis with the load chain. It provides load stabilization in the event of a catastrophic load chain failure. This unique feature has a US Patent NO. 10,099,904 awarded as of 2018.

2. INSTALLATION

Prior to installation, visually inspect the Smart Cart for signs of damage or missing parts.

	**CAUTION** **Knight Global recommends the use of Demag Chain Grease. The part number of the Demag Chain grease tube is 665 009 44.** **If Demag Chain Grease is not available, SAE 50 to 90 EP oil or equivalent may be used.** **Follow the procedure detailed in section 4.4.3 "Chain Lubrication" of this manual.**

	**CAUTION** **Prior to placing this unit into service, the owners and user are advised to examine specific local and/or other regulations, including ANSI and OSHA regulations that may apply to the use of this product.**

	**WARNING** **A falling load can cause injury or death. Before installing this cart read the "Safety" section of this manual.**

Follow all procedures in this section for installation and set-up of the Smart Cart.

Retain all product information supplied with the Smart Cart for future reference.

When installation is complete and prior to placing the Smart Cart into operation, inspect the Smart Cart following the instructions in section 4.4.2.1 "Recommendations for Periodic Inspections" of the "Maintenance" portion of this manual.

A. Introduction

Prior to installing and operating the Knight Smart Cart, all operators using this device should be familiar with the main components of the lifting system. (Refer to Figure 2-1)

Smart Cart: The Smart Cart assembly is a powered lifting device. The upper drive assembly contains the servo motor with holding brake, gearbox and chain bucket. The lower controls box contains the 24 VDC power supply and AC Plug and charger.

Control Handle: The main interface between the operator and the lifting device.

Foot Brake: Prevents the cart from moving unintentionally.

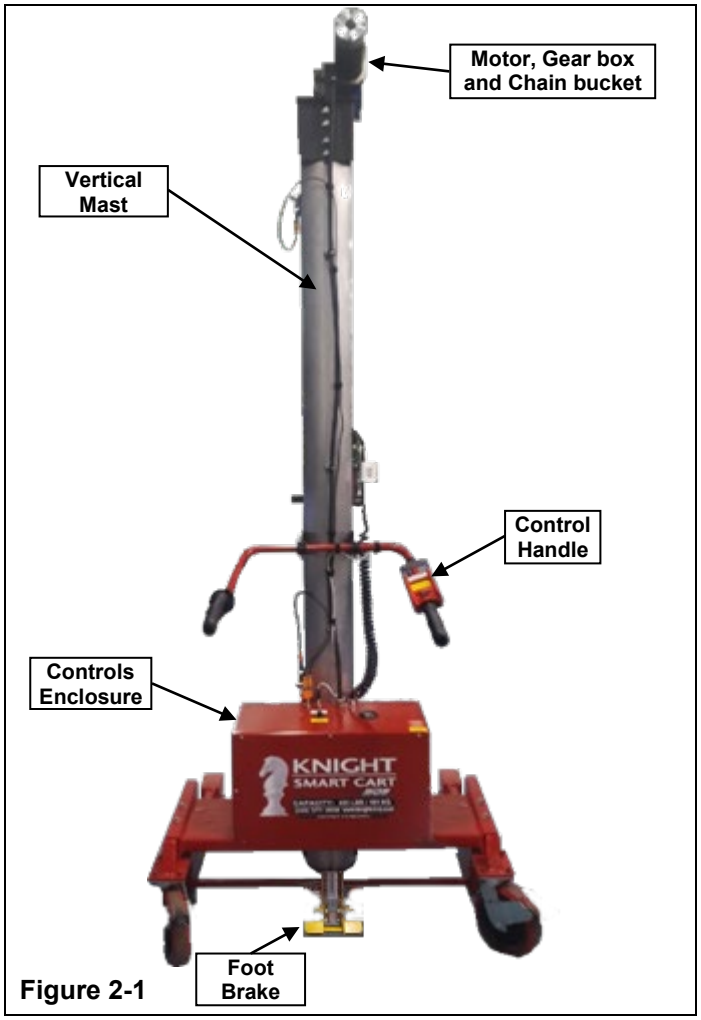


Figure 2-1

- This ergonomic lift cart is designed to assist the operator when lifting heavy loads up to 400 lbs.
- The lift assist system consists of a stabilizing cart and a fixture attached to a vertical mast.
- The fixture travels along the rail on the cart's load trolley, enabling the system to move vertically.
- The optional custom fixture holds the part or tool while it is being manipulated.
- Control handles are used to guide the load vertically and move the cart within your facility. System functionality are activated through the control handles.

B. General Operation

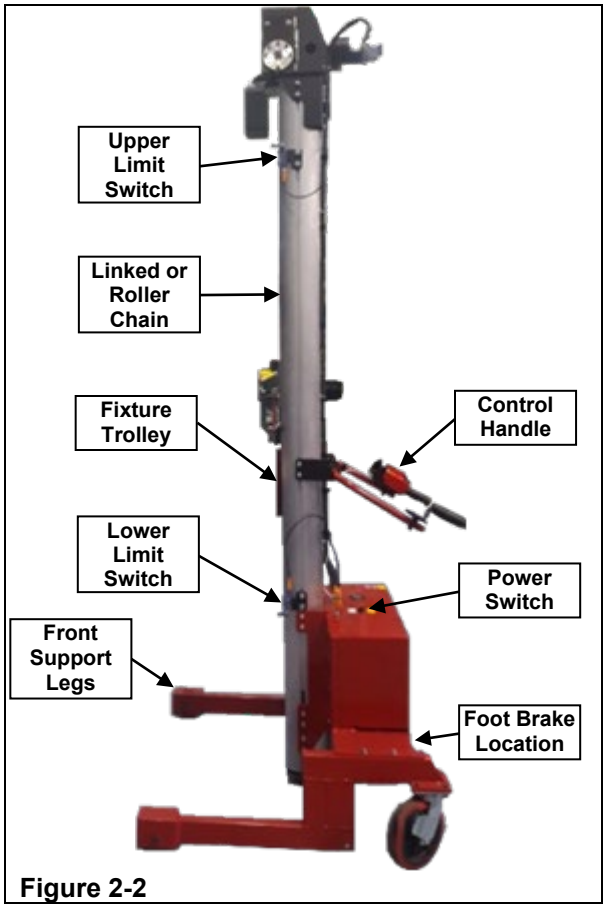


Figure 2-2

Power UP/DOWN

Power is controlled by the ON/OFF toggle switch. Move the toggle switch to the ON position to power up the Smart Cart. Move the toggle switch to the OFF position to power down the Smart Cart. (Refer to Figure 2-2)

Foot Brake

A brake is located in the center of the frame or on each castor depending on the design. Press down on the lever to set the brake.

Control Handle

The control handle can be adjusted to a comfortable working height by loosening the two (2) adjustment collars, moving the handle to the proper location and then retightening the adjustment collars.

Lift Control

The position of the platform or end effector is controlled with either a Right/Left analog lever or a digital Up/Down pushbutton located on the control handle.

Breaker

The breaker acts as overload/over travel protection.
The breaker will trip if the Smart Cart is used to lift a load that is beyond its capacity.
The breaker will trip if the upper or lower limit switch is bypassed, the lift is in the fully up or down position and the UP or DOWN button is held in the ON position.
Lastly, the breaker will trip if the speed control senses the motor draws more than 40Amps.

Step 1: Control Handle Set-up

There are (2) two control handle configurations. This section discusses the correct setup of each of these.

1a) Analog Lever Handle setup
1b) Discrete Up / Down Handle setup

Step 1a) Analog Lever Handle Setup:

1) The Analog Lever Handle comes standard with the system. (Refer to Figure 2-3)
2) If a new Analog Lever Handle has to be calibrated for the system, please follow these steps:
   i. Attached the 8-pin cable to the new handle and mount it to the cart's handle post.
   ii. Remove the Control Box's cover.
   iii. Press the Blue button located on the left-hand side of the battery. It will light up.
   iv. Press the Analog Lever fully to the Right.
   v. Press the Analog Lever fully to the Left.
   vi. Allow the Analog Lever to "rest" in its natural home position without moving it.
   vii. The Blue light will flash indicating that the new Analog Lever Handle has been calibrated.

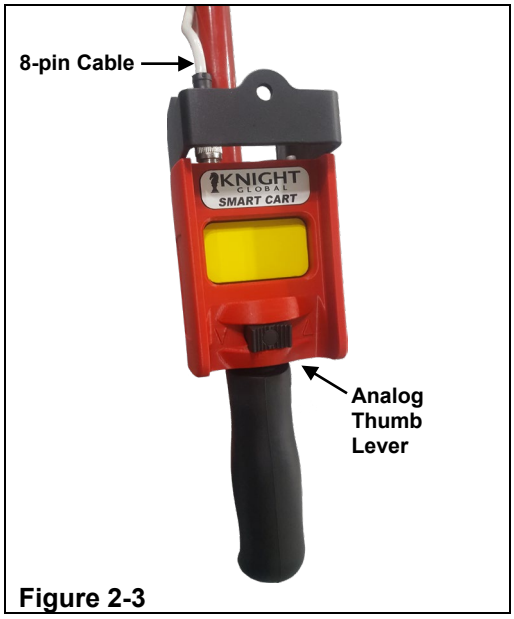


Figure 2-3

Step 1b) Discrete Up / Down Handle setup:

1) This handle is not standard with a new system. If one is required, please contact Knight personnel for instructions on how to calibrate the digital Up / Down handle.

Step 2: Test Cart Movement

Test the Smart Cart movement by moving the analog thumb lever on the control handle to the right and left. The fixture should move upward and downward freely. The speed of the movement will be directly proportional to the amount the thumb lever is moved past its center or rest position.

Step 3: Sequence of Operation

NOTE

As required, engage/disengage the caster brakes to prevent the cart from movement.

1. Position cart until the fixture is at a proper height to engage the part by use of the UP/DOWN control pendant. If necessary, engage the foot brake to prevent the cart from moving.
2. Ensure that cart has engaged part properly and transfer part to drop-off position.
   Note: If the foot brake was engaged in step 1, release the brake before moving the cart.
3. Use the thumb lever to position part at a proper height for the drop-off location.
4. Unload the part from cart. If necessary, engage the foot brake to prevent the cart from moving.
5. Remove fixture from drop-off location and return to starting location.
   Note: If the foot brake was engaged in step 4, release the brake before moving the cart.
6. Repeat operation.

3. OPERATION

A. Principle of Operation

The Smart Cart system receives a command to move up or down along the “Z” axis by pressing the analog thumb lever right and left. (Refer to Figure 3-1)

Smart Cart Control Configurations

Figure 3- 1

NUMBER	DESCRIPTION
1	Motor, Gear Box and Chain Bucket: Standard with all Smart Carts.
2	Analog Control Handle.
3	8-pin cable: Standard length, pre-wired.
4	Contorls Enclosure: Stadard with all Smart Carts.
5	On / Off Power Switch for Smart Cart.
6	Charge Meter.
7	AC Charger Cord.
8	Optional: Digital Control Handle.

B. Smart Cart Functionality Modes

Shut Down

Step 1. Turn off the power switch located on the controls box.

Step 2. Plug in the unit to 120VAC power to charge the battery.

Start Up

Step 1. Unplug the unit, if it is charging.

Step 2. Turn on the power switch located on the controls box.

Work Mode

Turn the power switch to the ON position and it will turn GREEN.

- The GREEN indicator will illuminate.

Systems with Analog Lever Style Lift Controls:

Step 1. Press the analog thumb rocker switch to the left or right to move the cart upwards or downwards.

Systems with Discrete Up / Down Style Lift Controls:

Step 1. Press the left lever to move the cart in the downward direction and right lever to move the cart in the upward direction.

Travel Limits

NOTE

During operation the cart will ramp down in speed as the travel limits are triggered.

NOTE

The absolute upper and lower travel limits are factory set to the physical limits of the Smart Cart.

Fault Mode

The speed controller board is located under the cover. It has a fault LED that designates if a system fault occurs. This table shows the LED Flashing frequency depending on the current fault.

Fault Number	Fault / Signal from Controller	LED Flashing Frequency
1	Power On	One blink.
2	Current Limit Fault	Led is lit solid.
3	Current Trip Fault	Blinks fast with no pauses.
4	Zero-Current Trip Fault	Long blink and a short pause.
5	Overvoltage Fault	Blinks fast (4) four times and a long pause.
6	Overheat Fault	Short blink and a long pause.
7	Timeout Fault	Blinks fast (3) three times and then a long blink.
8	Input Fault	Blinks fast (2) two times and then a long blink.

4. MAINTENANCE

A. CHAIN INSPECTION

4.1 Inspection Overview

The inspection procedures and recommendations in this manual are based on ANSI/ASME B30.16 “Overhead Underhung and Stationary Carts” and ISO7592-1983 “Calibrated Round Steel Link Lifting Chains -- Guidelines to proper use and maintenance.” The following definitions and recommendations are from both specifications and pertain to the recommended inspection procedures in this manual.

Qualified Person: A person who, by possession of a recognized degree in an applicable field, or certificate of professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter at work.

Designated Person: A person selected or assigned by the employer or the employer’s representative as being competent to perform specific duties.

Abnormal Operating Conditions: Environmental conditions that are unfavorable, harmful, or detrimental to the operation of a cart, such as excessively high or low ambient temperatures, exposure to weather, corrosive fumes, dust laden or moisture laden atmospheres, and hazardous locations.

4.2 Use of LIFT Safely in Any Application

Don't stack multiple objects on the Smart Cart. These are designed to lift one object at a time.	
Do not pull the Smart Cart long distances. The cart is designed to be pushed over level ground.	
Do not lift a heavy load onto the Smart Cart.	

4.3 Determining the Frequency of Chain Inspections

Knight recommends utilizing load criteria and duty cycle data when determining the frequency of inspections. Inspection frequency should be identified by a qualified person and is based on factors such as the severity of the environment the cart is being used in, percentage of capacity lifts, cycle time and shock loading. Each Smart Cart should be rated individually and inspections performed in accordance with that rating.

Proper maintenance depends on an evaluation of the severity of usage to which the cart and the chains are subjected to in the specific application.

The overall determination of how often the cart and chains should be inspected is a combination of its Service Rating Load Criteria (4.3.1) and its Service Class or Duty Cycle (4.3.2).

4.3.1 Service Rating Load Criteria

Light Service: Cart and chains normally subjected to light loads and very rarely to maximum loads.

Moderate Service: Cart and chains normally subjected to moderate loads but fairly frequently to maximum loads.

Heavy Service: Cart and chains normally subjected to loads of heavy magnitude and frequently to maximum loads.

Very Heavy Service: Cart and chains regularly subjected to maximum loads.

4.3.2 Service Class (Duty Cycle)

Service Class is determined by the total number of cycles the system has performed. (Table 4-1)

- Service Class 0: 0 to 20,000 loaded cycles.
- Service Class 1: 20,001 to 100,000 loaded cycles.
- Service Class 2: 100,001 to 500,000 loaded cycles.
- Service Class 3: 500,001 to 2,000,000 loaded cycles.
- Service Class 4: over 2,000,000 loaded cycles.

Cycles Per Day	Desired Life (Years)				
	1	5	10	20	30
5	0	0	0	1	1
10	0	0	1	1	2
25	0	1	1	2	2
50	0	1	2	2	3
100	1	2	2	3	3
200	1	2	3	3	4
300	2	3	3	4	4
750	2	3	4	4	4
1,000	2	3	4	4	4

Table 4-1: Service Class

Example: If the system is performing 100 cycles per day, it will progress though Service Classes during its use:

1 year	26,000 cycles	Service Class 1
5 years	130,000 cycles	Service Class 2
10 years	260,000 cycles	Service Class 2
20 years	520,000 cycles	Service Class 3
30 years	780,000 cycles	Service Class 3

4.4 Type of Inspections

The inspection procedure is divided into two general classifications based upon the intervals at which the inspections should be performed for the cart and chains during regular use. The general classifications are herein designated as "frequent" and "periodic" with respective intervals between inspections as defined below.

In addition, visual observations shall be conducted during regular service for any damage or evidence of malfunction which might occur between regular inspections.

4.4.1 Frequent Inspection (Visual)

This is a visual examination of the cart and its chains by the operator or other designated personnel, without requiring records to be made. This inspection should be carried out at the following intervals:

A.	Light Service	or	Service Class 0 / 1	– **Every Month**
B.	Moderate Service	or	Service Class 2	– **Every Two Weeks**
C.	Heavy Service	or	Service Class 3	– **Every Week**
D.	Very Heavy Service	or	Service Class 4	– **Every Day**

Additionally, the operator should check the system continually during operation to ensure that no malfunctions are occurring (such as abnormal noises or binding of the chain).

4.4.1.1 What to Look for During a Frequent Inspection

Operator should examine the chain throughout its working length to detect any evidence of wear, distortion or external damage. Equipment should be operated under a load as near as possible to the usual operating load, in both directions and observe the functioning of the chain. The chain should feed smoothly into and out of the tower unit. Additionally, the operator should check the system continually during operation to ensure that no malfunctions are occurring.

- Check for visual signs or abnormal noises (grinding etc.) which would indicate a potential problem.
- Ensure controls function properly and return to neutral when released.
- Ensure the load chain feeds through the tower unit correctly.
- Ensure that the chain doesn’t bind, is excessively noisy or “clicks” as it leaves the bottom of the tower unit.

If any of these abnormal conditions are evident, the Smart Cart should be taken out of service and a detailed inspection and corrective actions should be taken by qualified maintenance personnel.

4.4.2 Periodic Inspection (Documented)

This is a thorough examination of the cart and its chains conducted by a qualified person, making records of external conditions to provide a basis for the cart's continuing evaluation. This Inspection should be carried out at the following intervals:

A. Light Service or Service Class 0/1 – **Yearly**
(equipment remains in place).

B. Moderate Service or Service Class 2 – **Every Six Months**
(equipment remains in place unless external conditions indicate that disassembly should be done to permit detailed inspection).

C. Heavy Service or Service Class 3 – **Every Three Months**
(equipment remains in place unless external conditions indicate the disassembly should be done to permit detailed inspection).

D. Very Heavy Service or Service Class 4 – **Every Six Weeks**
(equipment remains in place unless external conditions indicate that disassembly should be done to permit detailed inspection).

4.4.2.1 Recommendations for Periodic Inspections

Perform the inspection detailed under section 4.4.1.1 "What to Look for During a Frequent Inspection" of this manual.

Next, the chains should be cleaned for inspection, using any cleaning method that will not cause damage. Adequate lighting should be provided for the person inspecting the chain. The chain should be examined link by link for cracks, gouges, nicks, distortion, corrosion, deposits of foreign material, and for interlink wear. To inspect for wear at the interlink contact points, slacken the chain and rotate adjacent links to expose the inner surface of the link. If wear is observed or if elongation is suspected, measure the chain using a chain gauge for the Smart Cart.

A. Chain Link Thickness

If chain is worn to less than the minimum allowable thickness (T), remove the chain from service. (Refer to Figure 4-1)

Minimum Allowable Chain Link Thickness at Any Point

Nominal Chain Size		Minimum Thickness "T"	
Inches	mm	Inches	mm
.157	4.0	.137	3.48
.196	5.0	.171	4.35

Figure 4-1

B. Linked Chain Gauge Replacement Measurement for 4mm and 5mm Linked Load Chains

1. Determine which type of linked chain is being inspected, either 4mm or 5mm, by placing a single link into the chain gauge where the arrows are located. (Refer to Figure 4-2)
2. Raise the cart to the full up position and mark the chain.
3. Lower the cart to the full down position.
4. Select 13 links starting with the link that was marked in step 2.
5. The 13-selected links should fit loosely onto gauge prongs as shown below. If links number 1 and 13 do not fit onto prongs or have to be forced into selection, replace the load chain. This length has stretched 2% or more and should be removed from service and replaced with new chain.
6. Perform this inspection in multiple sections of the chain working up to the sprocket.

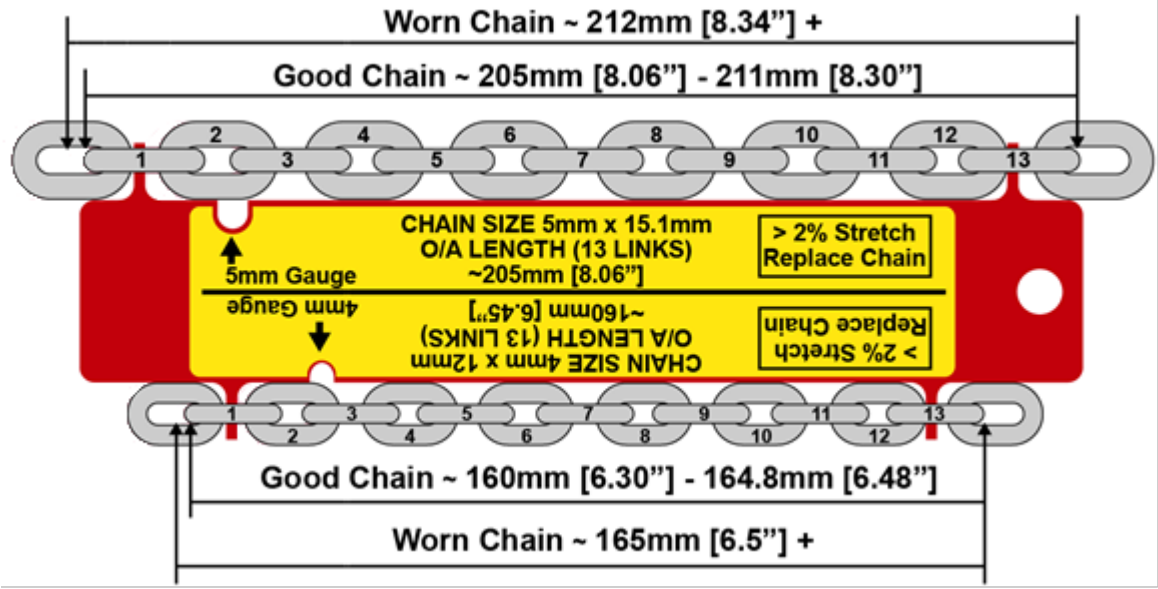


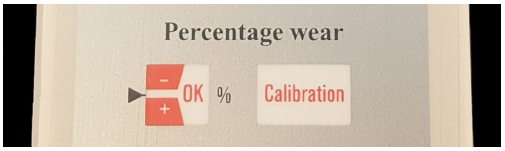
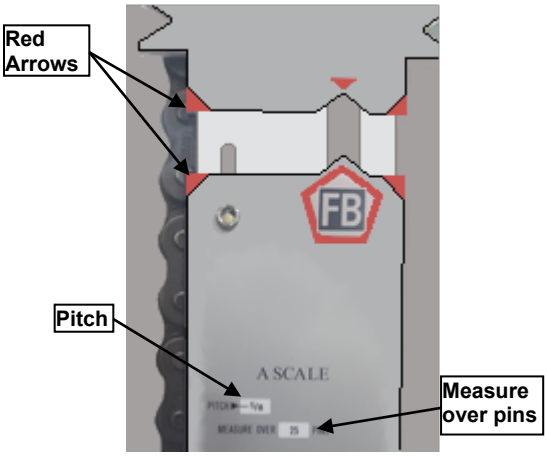
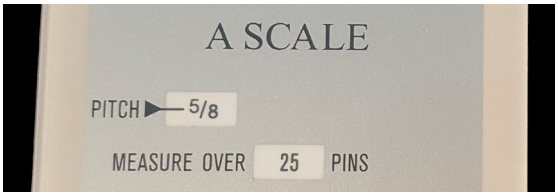
Figure 4-2

C. If Chain Gauge is Not Available

- Select an unworn, un-stretched length of the load chain.
- Suspend the chain vertically under tension. Use a caliper type gauge to measure the accumulated pitch of between 5 and 13 links.
- Measure the same number of links throughout the used chain and calculate the percentage increase in length.
- The chain should be replaced if the gauge length measured over any 5, 7, 9, 11, or 13 links as appropriate exceeds that of the unused chain by 2%.

D. Roller Chain Gauge Inspection Process

- If your cart uses Roller Chains, they should be cleaned for inspection, using any cleaning method that will not cause damage.

1. <u>Close gauge to confirm calibration:</u> Check the calibration by closing the slide fully.	
2. <u>Read the 'Percentage Wear' window:</u> When the gauge is fully closed, if the black arrow moves into the '+' or '-' zones, the gauge will not give an accurate measurement and should NOT be used. Similarly, if the 'V' jaws are damaged the instrument may also not perform accurately.	
3. <u>Identify the pitch:</u> Align the red arrows within the center of the pins on ONE of the OUTER link plates. Depending on ease of access, one pair of arrows will be more suitable than the others. The normal pitch will appear in the 'Pitch' window. The number of pins (n) that the chain is to be measured over will appear in the 'Measure over pins' window.	
4. <u>Select the Correct side of the gauge:</u> Select the correct scale according to pitch size. Once the pitch is determined, the number of pins to measure is displayed. Knight's Roller Chain uses the "A Scale" side. NOTE: "A Scale" side = 3/8", ½", 5/8", ¾", 1", 1 ¼", 1 ½", 2 ½", and 3". "B Scale" side = 1 ¾" x 2"	

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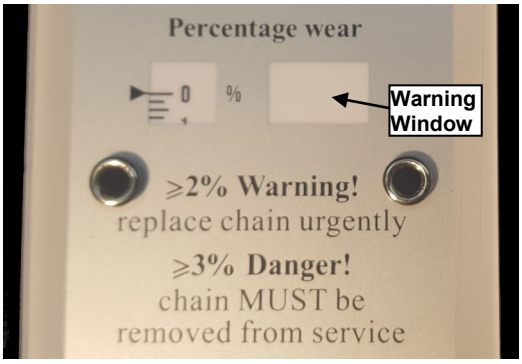
5. <u>Measure the Chain:</u> The chain should be cleaned and measured in its location while placed under approximately 1% of the minimum breaking load. If a set of check weights is not available, it is sufficient for the chain to be tensioned by the weight of the carriage and lift assist. Identify the section of the chain that regularly runs over the pulley as this part of the chain is most susceptible to wear. Measurements must then be made in at least 3 separate locations on this section. Place the 'V' jaw of the chain gauge over the first pin of one of the selected sections and then extend the slide until the other 'V' jaw reaches the final pin. The final pin will be the one that appeared in the 'Measure over pins' window as previously determined in step 3.	
6. <u>Read off the Percentage:</u> Check the 'Percentage Wear' windows. A percentage will appear in 0.25% (¼%) increments. If the chain has elongated by 2% or more, the warning window will be filled with red and necessary action must be taken.	

E. Lubricating the Servo Arm Roller Chain after replacement

- After changing the roller chain, before a test load is lifted and before the hoist is put into operation as well as during normal operation when no load is attached, the chain link contact areas must be lubricated with Demag gear grease, part no. 665 009 44.

- The chain link contact areas must be re-lubricated appropriately – after being cleaned – at intervals depending on the service and load conditions.

- Cut off the tip of the grease tube and inject grease into the chain's links by compressing the tube while you run the chain to its end positions to ensure complete and even lubrication of the chain.

F. Rejection Criteria

The chain should be rejected and replaced if any of the following conditions are observed: (Refer to Figure 4-3)

- Cracked or worn links
- Severe nicks or gouges
- Twisted or bent links
- Severe corrosion
- Deposits which cannot be removed
- Increase in gauge length which exceeds the manufacturer's recommendations. In the absence of manufacturer's recommendations, the chain should be replaced if the gauge length measured over any 5, 7, 9, 11, or 13 links as appropriate exceeds that of the unused chain by 2%.

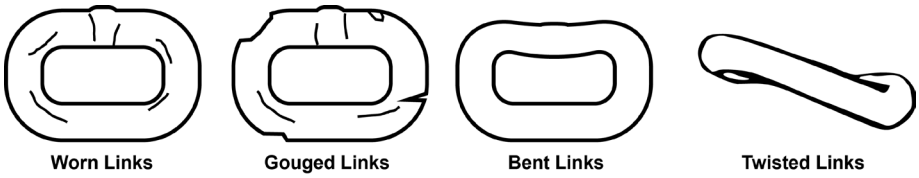


Figure 4-3

4.4.2.2 Recommended Record Keeping for Periodic Inspections

Adequate records as a part of periodic inspection are essential for the proper use of calibrated chains. The chain record should include a complete description and identification of the new chain, the date and results of each inspection, the date and results of each test and the date and description of any maintenance.

The record is a continuous history of the chain and shows that it has been regularly inspected and maintained in good operating condition.

When the chain is removed from service, a new record should be prepared for the replacement chain.

4.4.3 Chain Lubrication:

Keep chain well lubricated. Never operate a cart when the load chain does not flow freely and smoothly into and out of the gear box assembly or when it makes noises indicative of binding or other malfunctions. Replace the chain if it is visibly damaged in any way.

Clean, lubricate, and inspect the load chain based on the frequent inspection criteria described in section 4.4.1. In a corrosive environment, lubricate more frequently than normal. Failure to maintain a clean and well lubricated load chain will result in rapid load chain wear that can lead to chain failure which can cause severe injury, death or substantial property damage.

If required, clean the chain with acid free solvent to remove rust or abrasive dust buildup before the chain is lubricated.

Lubricate each link of the chain with a light coat machine or gear oil. Knight recommends using Demag Chain Grease (P/N 665 009 44). Ensure that oil is applied to all roller chain links and rollers. (Refer to Figure 4-4: Chain Lubrication – P/N 665 009 44). If Demag Chain Grease is not available, SAE 50 to 90 EP oil or equivalent may be used.

Substitute a dry lubricant for use in dusty environments. Lubricate hook and safety latch pivot points with same lubricant used on the load chain.

Lubricate chain without load on chain. This will allow lube to penetrate between links.

WARNING

Failure to maintain clean and lubricated load chain will void the manufacturer's warranty.

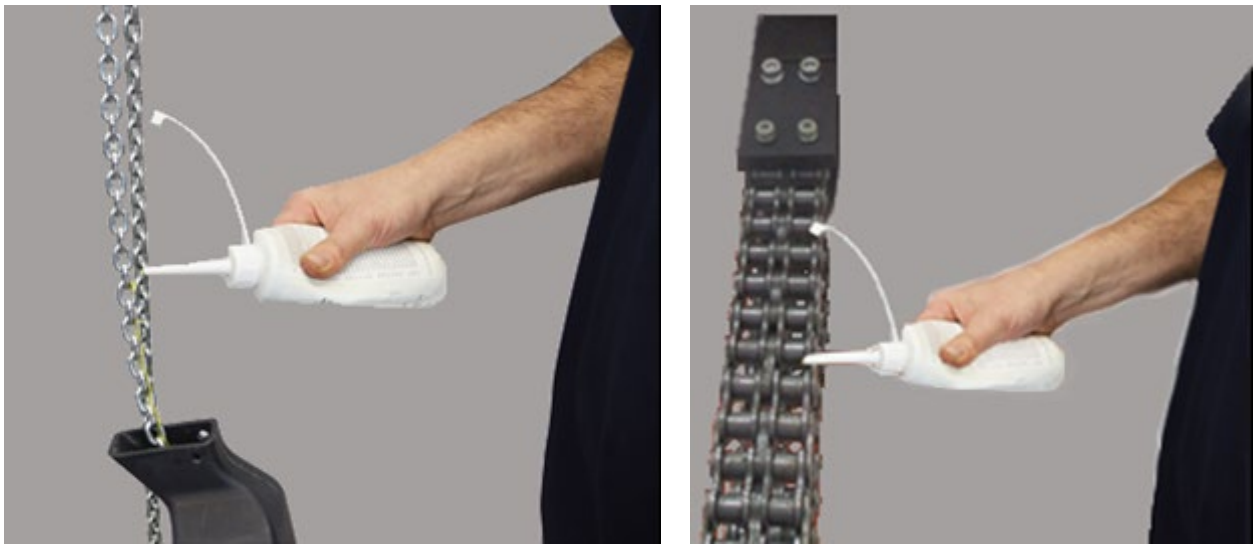


Figure 4-4: Chain Lubrication – P/N 665 009 44

4.4.4 Load Chain Replacement:

Care should be taken to re-install the chain without any twists down the entire chain's length between the gear box and its anchored end in the chain nest. Proper orientation of the entering link should be established since a twist cannot be corrected except by removing and re-installing the chain.

Refer to 4.6 "Load and Safety Drop Stop Chain Replacement (Normal Maintenance)" for further instructions on how to replace load chain.

B. PREVENTATIVE MAINTENANCE FOR KNIGHT SMART CART

4.5 Smart Carts Inspections

4.5.1 Recommendations for Frequent Inspections for Smart Carts (Visual)

This is a visual examination by the operator or other designated personnel, without requiring records to be made. Inspection should be carried out at the following intervals recommended in section 4.4.1 'Frequent Inspection (Visual)'.

Additionally, the operator should check the system continually during operation to ensure that no malfunctions are occurring.

4.5.1.1 Smart Cart:

- Visually inspect the Smart Cart and ensure that it is in good general working order. Repair or replace any broken or missing parts.
- Cycle the Smart Cart and listen for any abnormal noises (grinding, etc.). If any abnormal noises are evident, an inspection of the Smart Cart must be performed.
- Inspect how the chain feeds through the Smart Cart. If any binding is evident, clean and lubricate the chain (Refer to section 4.4.2 'Periodic Inspection (Documented)'. If the problem persists replace the chain.
- Cycle the ON / Off switch and ensure it functions correctly.

4.5.1.2 Trolley:

- Check all of the trolley wheels to ensure they rotate smoothly and are not damaged.
- Confirm all cotter pins and / or keepers are in place.

If any of these abnormal conditions are evident, the Smart Cart should be taken out of service and a detailed inspection and corrective actions should be taken by qualified maintenance personnel.

4.5.2 Periodic Inspection (Documented)

Perform the items listed in the section 4.4.1.1. 'What to Look for During a Frequent Inspection' in addition to the items listed below. All findings from this inspection should be recorded.

4.5.2.1 Wiring:

- Check for broken, loose, missing, and worn wires. Check all electrical cables for signs of age, wear, or damage, and make sure all connections are tight and secure. Repair or replace if needed.

If any of these abnormal conditions are evident, the Smart Cart should be taken out of service and a detailed inspection and corrective actions should be taken by qualified maintenance personnel.

Electrical Maintenance – ***(To be performed by qualified electrical personnel only)***

ITEM	FREQUENCY	MAINTENANCE
Control Handles	Weekly	Check for function. (Replace if needed).
Valves, Timers, and Switches	Weekly	Check during an operation cycle to ensure the sequence is operating at optimum efficiency.
Wiring	Monthly	Check for broken, loose, missing, and worn wires. Check all electrical cables for signs of age and make sure all connections are tight and secure.
Electrical Enclosures	Quarterly	Check for obvious signs of damage and repair as necessary.
Disconnect Boxes	Quarterly	Verify disconnect is operational. Check for loose, bent, or broken components.
Circuit Breakers	Quarterly	Inspect for loose or broken terminals. Check for the presence of contaminants like dirt, dust, grease, or rust.

General Maintenance

ITEM	FREQUENCY	MAINTENANCE
Battery	Daily	Ensure battery is free from damage and contact surfaces are free of any contamination.
		Ensure that battery is charged. Refer to “Charging the Battery” section in this manual.
Casters	Daily	Ensure bolts are tight and no damage is evident.
Fasteners	Daily	Check for missing or loose fasteners.
Entire System	Daily	Check for damage that may hamper free movement.
Pads and Latch	Daily	Wipe contact surface of pads and latch with a clean rag. Ensure contact surface is free of any contamination.
	Daily	Inspect pads and latch for wear or damage.
Welds	Monthly	Inspect welds and ensure that they are intact, no cracks, or broken spots.
Wiring	Monthly	Ensure that wiring is intact and not cut or frayed.
Lubricate Chain	Quarterly	Inspect and lubricate chain when dry.
Manual Slides and Bearings	Semi-annually	Lubricate with Mobil MOBILUX EP 1 641282-00 grease or equivalent.
Chain Elongation	Yearly	Inspect chain for elongation either manually or with a chain wear gauge.

Inspections

A quick inspection of the system should be made at the beginning of each shift. A thorough inspection should be made at least twice per year. Inspection records should be dated, signed, and kept on file.

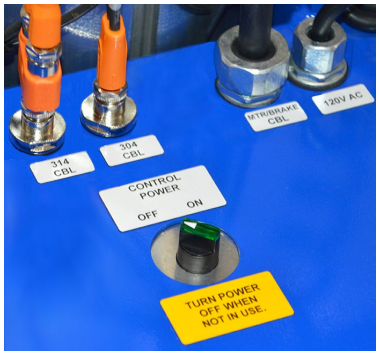
Contact a Knight Representative if there are any additional questions or concerns.

4.5.2.8 Labels and Tags:

- Ensure that all labels are intact and legible. Replace as necessary. (Refer to Figure 4-5)

Knight and Warning Labels

On/Off and Cable Tags



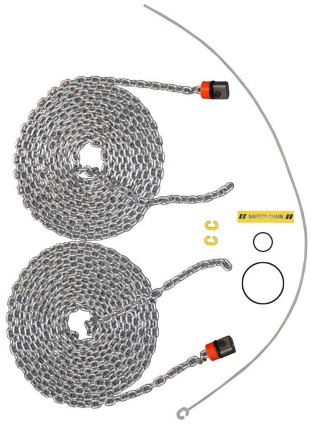
Enclosure Label

Figure 4-5

If any of the labels or warning tags listed above are missing, contact Knight Global at (248) 377-4950 to order replacements.

4.6 Load and Safety Drop Stop Chain Replacement (Normal Maintenance)

The materials required for the chain replacement are shown in Figure 4-6:



SDS REPLACEMENT CHAIN KIT
#KDSA1010 (4mm Chain)
#KDSA1011 (5mm Chain)

(2) Steel Grade (80) Chains.
(2) Chain End Stop assemblies.
(2) Interface links to assist in installing the chain.
(1) Chain Installation Tool.
(1) Safety Chain Identification Sleeve
(1) Small O-Ring.
(1) Large O-Ring.

Figure 4-6

Step 1. Use the Down button to rest the cart's boom / fixture on a supporting surface. Ensure all of the boom / fixture weight is set down on the supporting surface.

Step 2. Using the Down button to slack the chain.

Step 3. Turn the cart's power OFF and ensure that the cart is unplugged.

Step 4. Remove both chains from the chain nest. The bottom bolt releases the Safety Drop Stop (SDS) chain and the top bolt releases the Load chain.

A 4mm allen wrench will be required to accomplish this.

(Refer to Figure 4-7)

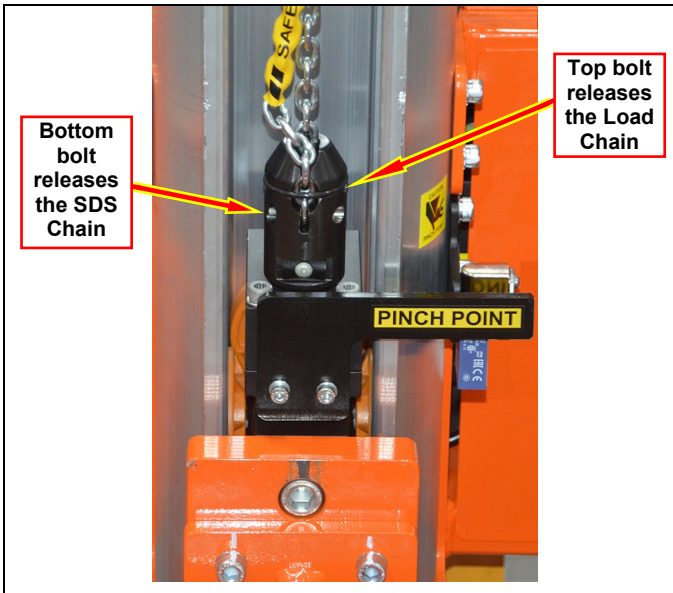


Figure 4-7

Step 5. Remove the bottom bolt and the SDS chain first and then remove the top bolt and load chain. Ensure that cart's boom / fixture is supported before the load chain is disengaged from the chain nest.

Step 6. While supporting the chain buckets, remove the (1) one M5 retainer bolt that secures both chain buckets to the mast. (Refer to Figure 4-8)

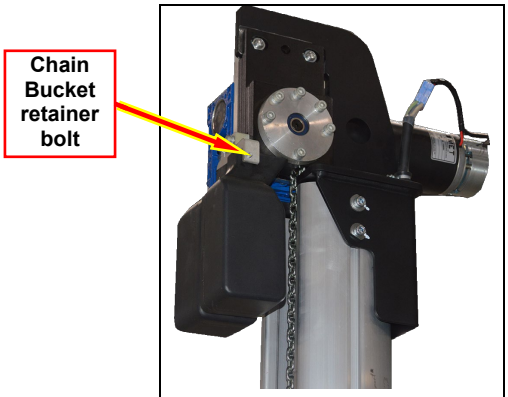


Figure 4-8

Step 7. Remove both chain buckets from the mast.

Step 8. Remove both chains from their individual chain buckets.

Step 9. Remove both of the end-stop assemblies from the each of the old load and Safety Drop Stop (SDS) chains.

Step 10. Connect both of the old chains together with the both of new chains by using both of the yellow chain interface links. (Refer to Figure 4-9)

Figure 4-9

Step 11. Turn the cart's power ON.

Step 12. Press the down button.

Step 13. Stop the movement of the chains when the yellow interface chain links have moved through the gear box and are at an acceptable height to reattach the cart's trolley.

Step 14. Lubricate both the load and the Safety Drop Stop (SDS) chains per section 4.4.3 'Chain Lubrication'.

Step 15. Reinstall both chains into each of their correct chain buckets.

Step 16. Reinstall the chain buckets back to the mast.

Step 17. The SDS chain needs to be cut to the correct length so it has slack in it when the load chain is properly connected.

Step 18. Ensure that both chains are parallel with no twists from the gear box down to their respective ends.

Step 19. Count down FOUR links from the end of the load chain.
Cut the FIFTH link so the SDS chain is FOUR links longer than the load chain.

Step 20. Install the safety chain identification sleeve on the SDS chain and then heat shrink it to the SDS chain on the eighth link up from the bottom of the SDS chain. (Refer to Figure 4-10)

Figure 4-10

Step 21. Reinstall the new small O-ring around both the load and SDS chains.

Step 22. Ensure that both chains are parallel to each other and have NO twists in them when they are installed into the chain nest. (Refer to Figure 4-11)

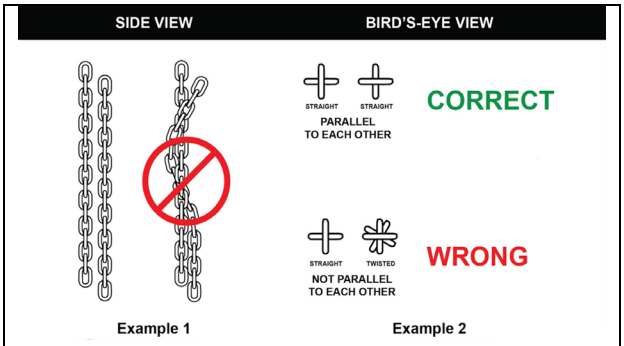


Figure 4-11

Step 23. First, the last link of the load chain is installed into the top slot of the chain nest. The chain must be kept parallel with no twists. The bolt is installed in front of the last link of the load chain and into the chain nest. (Refer to Figure 4-12)

Figure 4-12

Step 24. Next, the last link of the SDS chain is installed into the bottom slot of the chain nest. The chain must be kept parallel with no twists. The bolt is installed through the last link of the SDS and into the chain nest.

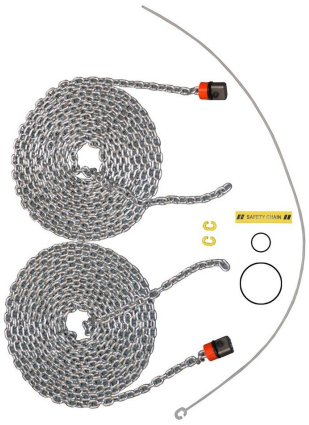
Step 25. Reinstall the large O-ring into the groove located on the chain nest. (Refer to Figure 4-12)

Step 26. Move the small O-ring down so it is just above the top of the chain nest.

Step 27. The cart may now be repowered and tested.

4.7 Broken Chain Replacement

The materials required for the chain replacement are shown in Figure 4-13:



SDS REPLACEMENT CHAIN KIT
#KDSA1010 (4mm Chain)
#KDSA1011 (5mm Chain)

(2) Steel Grade (80) Chains.
(2) Chain End Stop assemblies.
(2) Interface links to assist in installing the chain.
(1) Chain Installation Tool.
(1) Safety Chain Identification Sleeve
(1) Small O-Ring.
(1) Large O-Ring.

Figure 4-13

Step 1. Use the Down button to rest the cart's boom / fixture on a supporting surface. Ensure all of the boom / fixture weight is set down on the supporting surface.

Step 2. Using the Down button to slack the chain.

Step 3. Turn the cart's power OFF and ensure that the cart is unplugged.

Step 4. Remove both chains from the chain nest. The bottom bolt releases the Safety Drop Stop (SDS) chain and the top bolt releases the Load chain.

A 4mm allen wrench will be required to accomplish this.

(Refer to Figure 4-14)

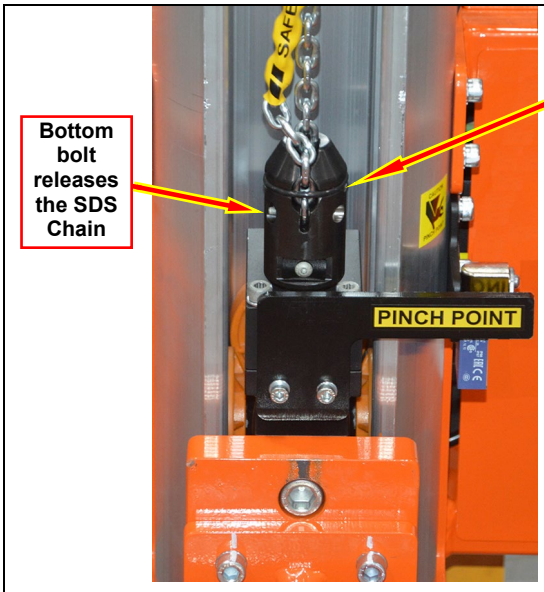


Figure 4-14

Step 5. Remove the bottom bolt and the SDS chain first and then remove the top bolt and load chain. Ensure that cart's boom / fixture is supported before the load chain is disengaged from the chain nest.

Step 6. While supporting the chain buckets, remove the (1) one M5 retainer bolt that secures both chain buckets to the mast. (Refer to Figure 4-15)

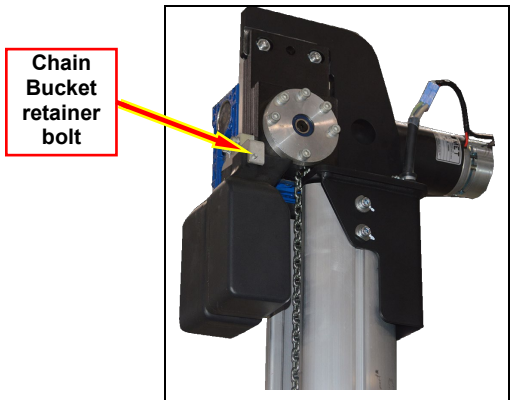


Figure 4-15

Step 7. Remove both chain buckets from the mast.

Step 8. Remove both chains from their individual chain buckets.

Step 9. Remove both of the end-stop assemblies from the each of the old load and Safety Drop Stop (SDS) chains.

Step 10. Using the chain installation tool, locate the load chain pocket opening on the bottom of the gear box. (Refer to Figure 4-16)

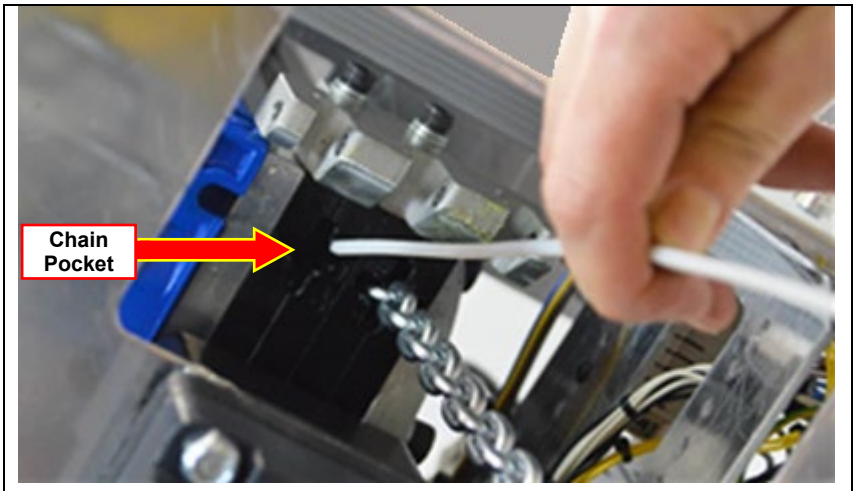


Figure 4-16

Step 11. While supporting the chain buckets, remove the (1) one M5 retainer bolt that secures both chain buckets inside of the Servo Hoist. (Refer to Figure 4-17)

Figure 4-17

Step 12. Turn the cart's power ON.

Step 13. Press the down button.

Step 14. Stop the movement of the chains when the yellow interface chain links have moved through the gear box and are at an acceptable height to reattach the cart's trolley.

Step 15. Lubricate both the load and the Safety Drop Stop (SDS) chains per section 4.4.3 'Chain Lubrication'.

Step 16. Reinstall both chains into each of their correct chain buckets.

Step 17. Reinstall the chain buckets back to the mast.

Step 18. The SDS chain needs to be cut to the correct length so it has slack in it when the load chain is properly connected.

Step 19. Ensure that both chains are parallel with no twists from the gear box down to their respective ends.

Step 20. Count down FOUR links from the end of the load chain.
Cut the FIFTH link so the SDS chain is FOUR links longer than the load chain.

Step 21. Install the safety chain identification sleeve on the SDS chain and then heat shrink it to the SDS chain on the eighth link up from the bottom of the SDS chain.
(Refer to Figure 4-18)

Figure 4-18

Step 22. Reinstall the new small O-ring around both the load and SDS chains.

Step 23. Ensure that both chains are parallel to each other and have NO twists in them when they are installed into the chain nest. (Refer to Figure 4-19).

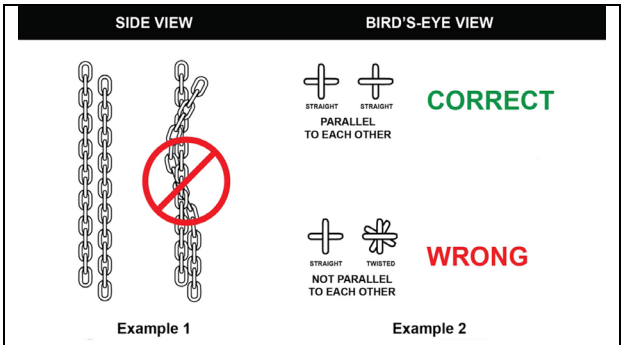


Figure 4-19

Step 24. First, the last link of the load chain is installed into the top slot of the chain nest. The chain must be kept parallel with no twists. The bolt is installed in front of the last link of the load chain and into the chain nest. (Refer to Figure 4-20)

Figure 4-20

Step 25. Next, the last link of the SDS chain is installed into the bottom slot of the chain nest. The chain must be kept parallel with no twists. The bolt is installed through the last link of the SDS and into the chain nest.

Step 26. Reinstall the large O-ring into the groove located on the chain nest. (Refer to Figure 4-20)

Step 27. Move the small O-ring down so it is just above the top of the chain nest.

Step 28. The cart may now be repowered and tested.

5. ELECTRICAL INFORMATION

A. CHARGING THE BATTERY:

The charger is a Meanwell Lithium Battery Charger (PB-360N-24).

The steps to charge the Lithium battery are:

1. Power down the Smart Cart.
2. Set the foot brake.
3. Plug the charger into a wall outlet.
4. Observe the charging LED. When it turns green, the battery is fully charged. (Refer to Figure 5-1)
   The batteries' charge can also be monitored via the phone application.
   See section 5.B. "Lithium-Ion Battery"
5. See the charging curve on the next page. (Refer to Figure 5-2)

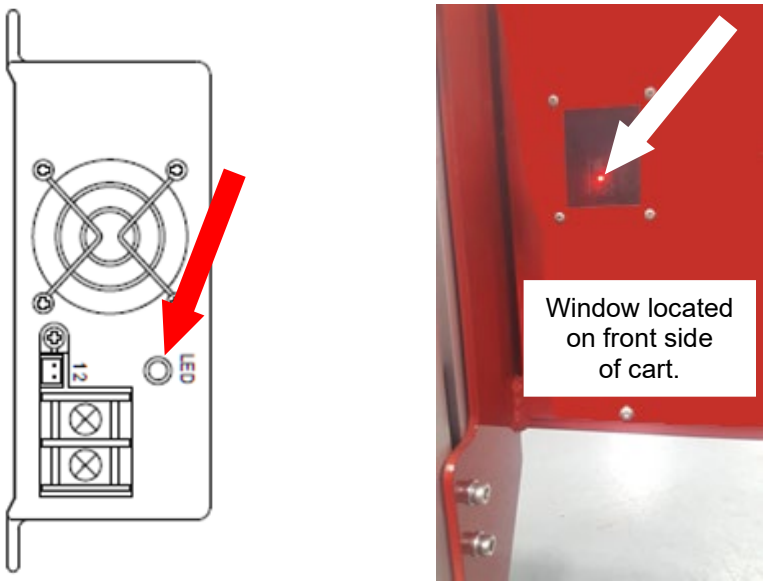
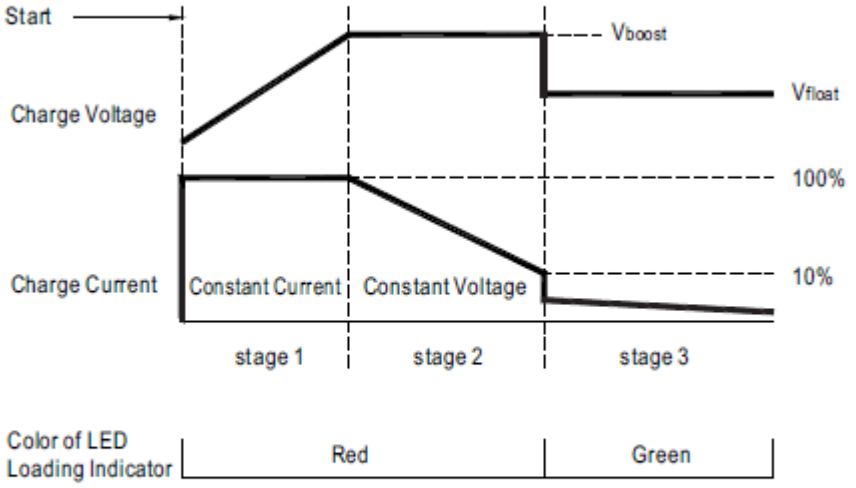


Figure 5-1

■ Charging Curve



State	PB-360-12	PB-360-24	PB-360-48
Constant Current	24.3A	12.5A	6.25A
Vboost	14.4V	28.8V	57.6V
Vfloat	13.6V	27.2V	54.4V

Figure 5-2

B. LITHIUM-ION BATTERY:

The lithium-ion battery (PSL-BT-24500) has a phone application named “Power Sonic” that will allow you to monitor its charge. The phone application will allow you to choose between any battery in any of the Knight Smart Carts you own. The phone application lists the State of Charge (SOC) of your battery, the batteries temperature and its cycle life. (Refer to Figure 5-3)

Figure 5-3

C. DC-MOTOR CONTROLLER INFORMATION

The DC-Motor Controller is an Electromen EM-243C-JS. This controller is a full bridge DC-motor starter. It can be programmed by using a cable and their custom programming software.

The location of the software is: https://electromen.com/en/products/item/download
The name of the software is: EmentoolLite v.1.53
The cable number is: EM-328 adapter

The location of the programming port on the charging board is shown below: (Refer to Figure 5-4)

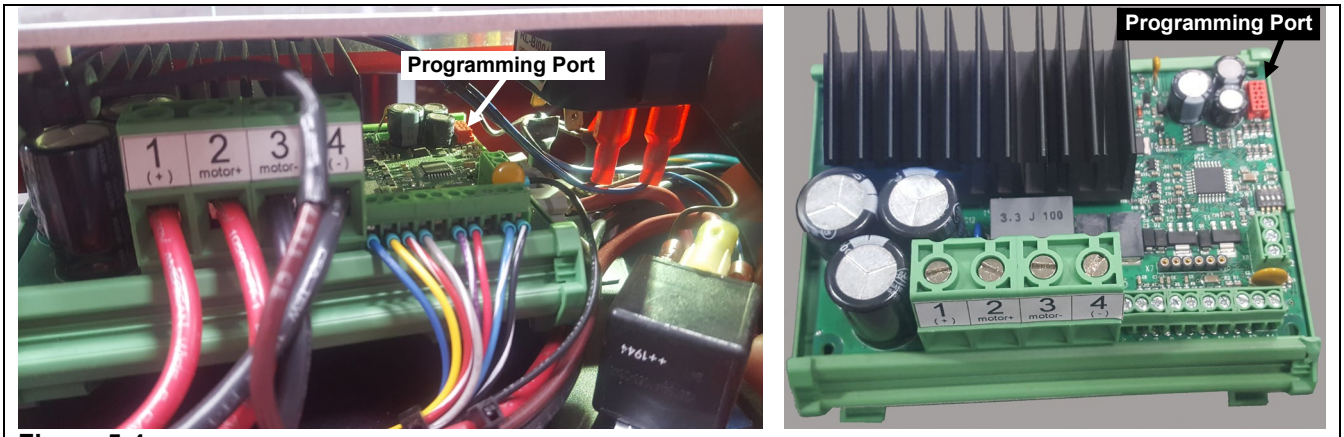


Figure 5-4

These are the Parameters settings that can be set by using the software listed above:

Parameter Number	Parameter's Name	Linked Chain Cart Setting	Roller Chain Cart Setting
1	Not Used	--	--
2	Stop Input Options	Do Not Change Setting	Do Not Change Setting
3	Input Logic for Limit inputs	1: PNP	1: PNP
4	Maximum Speed: Forward	100: Fixture moves *Up*	100: Fixture moves **Down**
5	Maximum Speed: Reverse	100: Fixture moves *Down*	100: Fixture moves **Up**
6	Current Limit: Forward	100: Fixture moves *Up*	100: Fixture moves **Down**
7	Current Limit: Reverse	100: Fixture moves *Down*	100: Fixture moves **Up**
8	Current Trip	1: Enabled	1: Enabled
9	Not Used	--	--
10	Fault Output Combinations	1: Multiple Fault Output	1: Multiple Fault Output
11	Overvoltage Limit	30	30
12	Load Compensation	2: Load Compensation	2: Load Compensation
13	Timeout	Do Not Change Setting	Do Not Change Setting
14	Reset for Start	Do Not Change Setting	Do Not Change Setting
15	Start Ramp	50	50
16	Stop Ramp	20	20
17	Start Kick	Do Not Change Setting	Do Not Change Setting
18	Dead Band Width	5	5
19	Freewheel Options	Do Not Change Setting	Do Not Change Setting
20	PWM Frequency	Do Not Change Setting	Do Not Change Setting
21	Brake Outputs Options	Do Not Change Setting	Do Not Change Setting

The DC-Motor Controller has a Fault LED located near the upper right-hand side of the controller. This LED blinks with a certain frequency if there is a problem with itself or the motor. (Refer to Figure 5-5)

Fault Number	Fault / Signal from Controller	LED Flashing Frequency
1	Power On	One blink.
2	Current Limit Fault	Led is lit solid.
3	Current Trip Fault	Blinks fast with no pauses.
4	Zero-Current Trip Fault	Long blink and a short pause.
5	Overvoltage Fault	Blinks fast (4) four times and a long pause.
6	Overheat Fault	Short blink and a long pause.
7	Timeout Fault	Blinks fast (3) three times and then a long blink.
8	Input Fault	Blinks fast (2) two times and then a long blink.

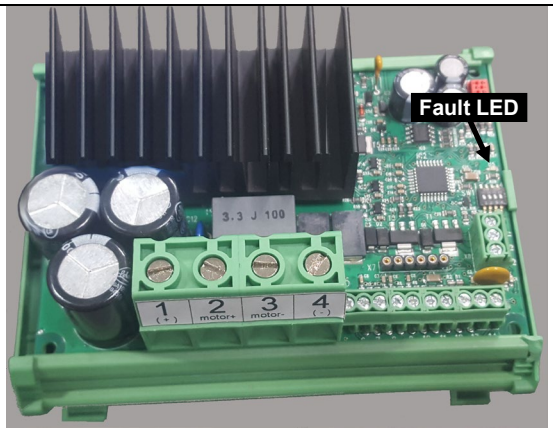


Figure 5-5

6. TROUBLESHOOTING CHART

The Smart Cart operation may be affected by various factors. If your cost is not performing as well as expected, follow the table below to diagnose the problem. If unable to resolve the issue, contact the Knight Service Department at 248-375-7962 or via e-mail at service@knightglobal.com.

Smart Cart Troubleshooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Smart Cart will not raise	Power not supplied to cart	Ensure power switch is in the “ON” position.
	System Faulted	Check Fault LED on controller. LED fault flashing patterns listed above.
	Batteries are discharged	Recharge the batteries. Ensure that the charger is plugged in and the charging light is ON.
	Damaged pendent or cable	Replace damaged pendent or cable.
	Electrical fault	Contact Knight Global Service Dept: (248) 377-4950.
	Weight overloaded	Remove excess weight from fixture.
Smart Cart is slow to raise or will not raise to the top	Batteries are discharged.	Recharge the batteries
	A Fault may exist with the motor/switch.	Contact Knight Global Service Dept: (248) 377-4950.
Smart Cart does not lower	Power not supplied to cart	Ensure power switch is in the “ON” position.
	Damaged pendent or cable	Replace damaged pendent or cable.
	Batteries are discharged	Recharge the batteries. Ensure that the charger is plugged in and the charging light is ON.
	Electrical fault	Contact Knight Global Service Dept: (248) 377-4950.
Smart Cart does not power up	Blown fuse	Check system fusing.
	Dead Battery	Check Battery’s charge level. Plug in system to 120VAC.
	Damaged switch or wire	Inspect wiring for problem.

Battery Charging Troubleshooting

PROBLEM	CAUSE	SOLUTION
Red LED stays on for more than 24 Hrs.	1. One or more defective or damaged cells. 2. Charger has reduced its output below the normal level due to a DC overload or a DC short. 3. On-board DC systems are drawing more current than the charger can supply.	1. Load test the batteries and replace as necessary. 2. Remove the source of the overload or short. Disconnect the charger's black (NEGATIVE) ring terminal from the battery. 3. Turn off all DC equipment while charging. **
Green LED stays on when the battery is known to be low.	1. Faulty or contaminated terminal connections. 2. One or more defective or damaged cells.	1. Clean and tighten or repair all battery to charger connections. 2. Load test the batteries and replace if necessary. **
Neither of the LED's turn on when the AC power is applied.	1. No AC power available at the charger. 2. Component failure.	1. Connect AC power or reset the AC breaker on the main panel. 2. Return charger to the Manufacturer.

** Please note that you can use the "Power Sonic" cell phone application to check the battery status.

7. SPARE PARTS LIST

Because Knight is continuously improving and updating its products, all product drawings and spare parts lists for this Smart Cart are provided as supporting documentation accompanying this manual and delivered with the system.

8. DECOMMISSIONING OF A SMART CART

Knight Smart Carts contain various materials which, at the end of the service life, must be disposed of or recycled (where appropriate), in accordance with local statutory regulations.

Decommissioning:

WARNING

Knight Smart Carts must be decommissioned by qualified personnel.

- Ensure there is not a load on the cart.
- Remove power from cart.
- Remove cart from rail or support structure.
- If desired, Knight Global will properly dispose of the cart. Contact a Knight Global representative to obtain a Return Material Authorization form.
- Recycle electronics and battery within the cart.

9. KNIGHT'S PERFORMANCE WARRANTY

Knight warrants that its products and parts shall meet all applicable specifications, performance requirements, and be free from defects in material and workmanship for one year, (Servo Systems for (2) two years, Pneumatic Lift Tables for (5) five years), from the date of invoice, unless otherwise noted.

Knight warrants the Smart Cart, Arms, and Tractors to be free from defects in material or workmanship for a period of two years or 6000 hours use from the date of shipment.

On design and build jobs, the customer is the owner of the equipment once they authorize shipment. The purchased equipment cannot be returned for reimbursement or credit.

Exclusions

This warranty shall not cover the failure or defective operation caused by inadequate training provided by customer regarding the operation and/ or maintenance of the tool, misuse, negligence, misadjustment, or any alteration not approved by Knight Global. Knight's obligation is limited to the replacement or repair of Knight's products at a location designated by Knight Global. Buyer is responsible for all associated internal removal and reinstallation costs as well as freight charges to and from Knight Global. Knight's maximum liability shall not in any case exceed the contract price for the products claimed to be defective.

Any field modification made to Knight Products or Systems without the written authorization by Knight Global shall void Knight's warranty obligation.

Any purchased components not manufactured by Knight Global and their specific individual warranties are not covered. Paint defects, scratches and marring from shipping are also excluded on all Knight Global products and products not manufactured by Knight Global.

Knight Distributors/ Agents are not authorized to circumvent or change any of these terms and/ or conditions of this warranty unless prior approval is received in writing by Knight Global Management. Verbal statements made by Knight Distributors/ Agents do not constitute warranties.

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10. APPENDIX A: USB LOCATION IN SMART CART MANUAL

Location of Electronic Knight Smart Cart Technical Manual and Documentation

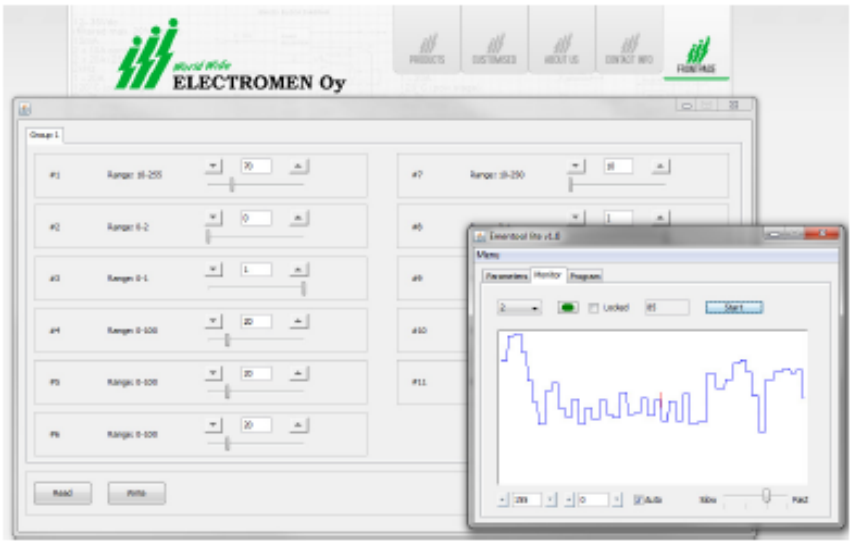
In an effort to reduce waste of natural resources, Knight has migrated to a complete set of controls documentation in electronic format that is located on a USB drive. This USB drive is created for each Knight Smart Cart order and is placed in the inside of the front cover of the Knight Smart Cart Technical Manual binder which ships with each job. Please refer to Figure 1 below.

Knight Smart Cart Technical Manual and USB Drive

Figure 1

11. APPENDIX B: EMenTool Lite v1.0: Programming Software

EMENTOOL LITE v1.0
User interface for EM-products

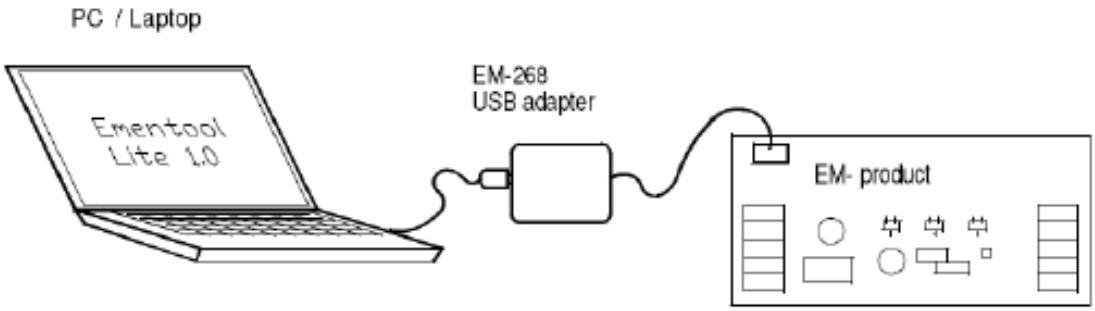


-parameter setting
-monitoring
-program update
-freeware

Ementool Lite program can be used to set Electromen products and for program updates. The program has three main views: setting of the parameters, monitoring, and program update. The target device is then plugged to a computer normally by using a EM-268 USB adapter.

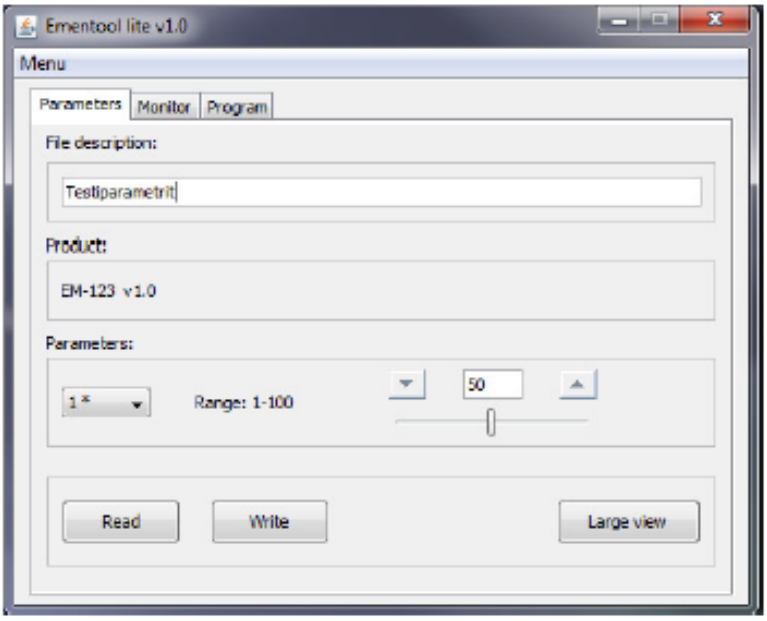
INSTALLATION
In order for the program to work, the computer must have a Java software installed which is already installed in most windows computers. If necessary it can be downloaded and installed freely from www.java.com.

1. Plug EM-268 adapter to the computer
2. Download the program http://www.electromen.com/EmentoolLite/EmentoolLiteInstall_v1.0.jar
3. Open/run *EmentoolLiteInstall_v1.0.jar* and install according to program's instructions.



Using

Plug EM-268 USB-adapter to the computer and connect the adapter's red connector to the target device's red connector. Start the program with an icon on the desktop and the view below should appear to the screen.



Parameters

After the program has started, a parameter setting view will open. By pressing read, the parameters are read from the the target device and the connected device's tag will appear on the "Product" field. "Write" will save the parameters to the target device's memory. In the basic view, you can only set one parameter at a time by choosing the adjustable parameter from the menu. In the "Large view" the parameters can be set in groups of 12 units. Parameters can be printed by selecting "Print" from the menu and saved to computer by selecting "Save file as". When saving the file you can use the "File description" field to add additional information about the saved parameters.

Monitoring

By choosing the Monitor-tab, there can be select values for monitoring. The values are drawn as curves on the printing area. The traceable value is selected from the menu and tracking begins by selecting Start. Several values can be tracked simultaneously by choosing "Locked" and moving on to the next value. Drawing area's scale can be automated by selecting "Auto" or the area can be manually scaled by writing the scale values on the boxes in the screen's lower edge.
For a more accurate examination, the curve's drawing can be stopped by pressing stop and then the values can be examined accurately with a pointer. By clicking the mouse in the drawing area the pointer will appear on the curve and follows mouse movements. By pressing again the pointer will be locked. By right clicking the mouse, the pointer will be removed.

Program update

The program-tab is used to update the target device. Save the update file (file extension .epg) to Ementool lite's folder, c:\ementoolLite\epg. Open the update file by selecting "Select prog". The update file's name, version and date will appear on the title field. Start updating by selecting "Program". Once the update has begun it cannot be interrupted. During the update it has to be made sure that the card is not plugged off or that the power is not cut off. Otherwise the update may fail and the card can be corrupted. The update is ready when a "Programmed" text will appear on the field.

12. APPENDIX C: EM-243C-JS1 DC-MOTOR CONTROLLER

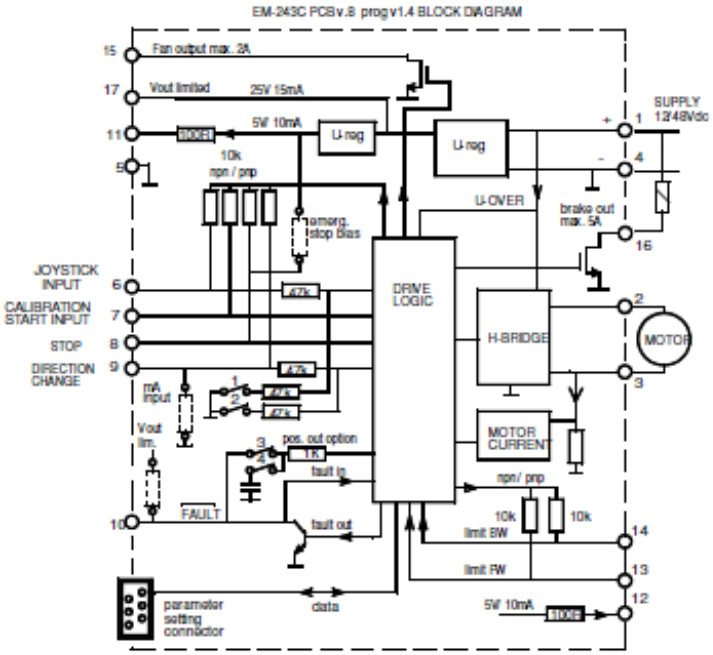
EM-243C-JS1 DC-MOTOR CONTROLLER 12-48V 50A

- JS1 is specially for joystick use
- three point calibration
- compact size
- for motor up to 500W
- high current output
- current limit
- overvoltage brake
- own speed ranges for FW and REV.
- rail base mountable
- digital parameter setting
- JS1 program can be update also for standard EM-243A or 243C boards
- Board version C has extended operating voltage 42V -> 48V
- Prog. 1.3 direction change input added
- Prog. 1.4 stop input, brake output and fan output ottions added

EM-243C-JS1 is a full bridge DC-motor starter. It is designed for joystick controlled DC-motor applications. The driver has adjustable acceleration and deceleration ramps, which enable the smooth starts and stops. Adjustable current limit protects the motor against overcurrent and it can also be used as an end-stop. This device has also two settable speeds, separate speed ranges for forward and reverse direction. Control input is specially designed for joystick control. The joystick range calibration is done automatically, when calibration function is activated. Calibration detects forward, reverse and midpoint positions. FAULT terminal has simultaneously both input and output functions, the pin is normally high, but is pulled down in overheat and conditionally also in current trip situation. If FAULT-line is pulled down externally it will cause a stop and prevent it from starting again. For example, it is possible to link fault pins of several units together and achieve a syncronous stop.
There are also special settings as start-kick which can be used in case the device is in danger of being jammed.
Limit input can be individually set for NPN or PNP logic.
The parameter's settings can be done with various EM- interface units. Operation of the controller and some of its functional values can also be monitored with interface units.

TECHNICAL DATA

Supply voltage nominal 12-48V, limits 10-58V
Start up voltage 9V, shutdown voltage 8V
Idle current typ 15mA
Motor current max. with 2kHz pwm
100% pwm 50A ,
20-99pwm% 35A and peak 100A (5s)
Motor current max. with 16kHz pwm
100% pwm 40A ,
20-99pwm% 20A and peak 60A (5s)
Current limit adjustable 1-100A
Notice! current limit is increased 50% at start
Overheat limit 100°C
Start and stop ramp adjustable 0-5s
PWM frequency 2kHz or 16kHz (selectable)
joystick input scale 0-5 or 0-10V (if dip 1 is ON)
Input control logic: high =4-30V, low=0-1V
Control input impedances typ. 10kohm
Control input response time typ 5ms.
Fault out. NPN open coll. max. 50V / 1A
Fault in actives Uin < 1V (NPN)
Brake output NPN max. 5A 60V
Fan output NPN max. 2A 40V
Motor and supply connectors 4mm
Control connectors 1mm
Dimensions 107x72x40mm
Dimensions in DIN-rail base 110x80x55mm
CE-tested for industrial environment (EMC)
Operating ambient temp (Ta) -40...60°C
Weight 190g



www.electromen.com
ELECTROMEN

CONNECTIONS

Supply voltage recomendation is 12-48VDC
and ripple should be less than 30% at full load.
Supply voltage limit is 58Vdc
CAUTION ! Wrong polarity can damage the unit.
CAUTION ! Unit doesn't have an internal fuse, so
an external fuse should be added if fuse required.

MONITORABLE VALUES

1/6 Motor current 0-20A (0-200)
2/6 PWM-level-% 0-100% (0-100)
3/6 hour counter (max.65535h)
4/6 start counter (max.65535)
5/6 carry counter for start counter
6/6 joystick position 0-1024

FAULT-LED signal codes

1. power on	one blink
2. current on limit	led is lit
3. current trip	fast blinking...
4. zero-cur trip	long blink- short pause...
5. overvoltage	4 x blink -pause...
6. overheat	short blink- long pause...
7. timeout	3 x blink + long blink...
8. fault input	2 x short + 1x long blink...

Special codes for calibration mode
solid light = calibration can be done
blink light = calibration is done

ADJUST AND SETTINGS (progver. EM-243C-JS1 v1.4)

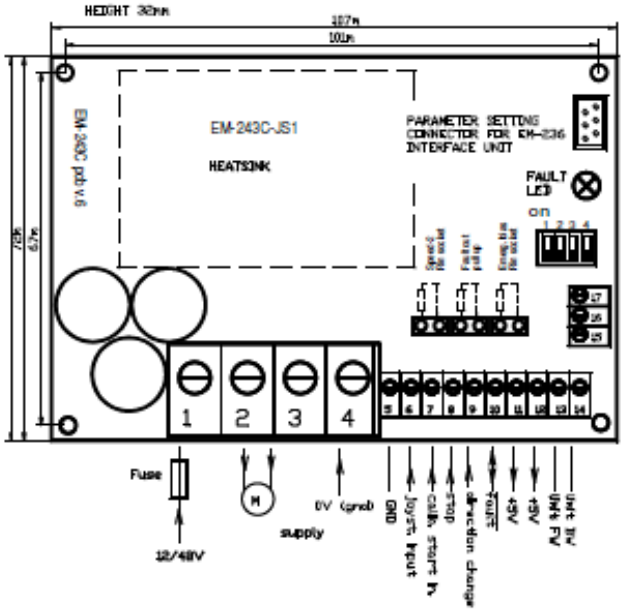
Adjusting and parameter setting of eg.
current limit value, ramp times and speed-2
value can be done with various EM-interface units
EM-236 is basic parameter setting device.
EM-268 and EM- 328 are USB-serial converters,
which makes it possible to set parameters also
with computer where is installed EmenTool Lite
program. EM-326 is Bluetooth -dongle which can
be used in smart devices with the EmenTool App.

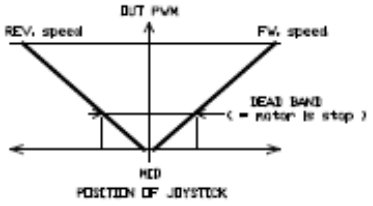
DIP SWITCHES

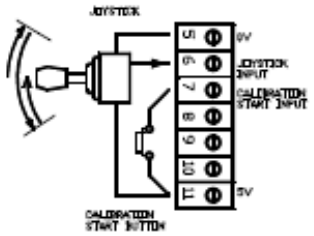
Dip-1 Damping pin 6 if set ON (joystick input)
Dip-2 Damping pin 9 if set ON
Dip-3 NOT in use keep always OFF
Dip-4 NOT in use keep always OFF

SETTABLE PARAMETERS 21pcs. prog. v1.4 (defaults in brackets)

1- not in use
2- stop input options 0-1 (input pin 8)
0= stop with command , new start is possible
1= stop command stops with ramp and stay stopped as long as command occured, it starts again when when command disappears
3- input logic for limit inputs 1 or 4 PNP/NPN (1)
1= limit inputs PNP 2= limit input NPN
3= limit inputs PNP N.C. 4=limits inputs NPN N.C
(N.C.= normally closed = open circuits stops.)
4- max. speed FW. 0-100% / 0-100 (100)
5- max. speed REV. 0-100% / 0-100 (100)
6- current limit FW. 1-100A / 1-100 (30)
7- current limit REV. 1-100A / 1-100 (30)
8- current trip 0= disabled, 1= enabled : (1)
9- not in use
10- Fault output combinations: 0-3 (1)
0= overtemp, current trip. overvoltage
1= as above + calibration indication
2= current limit indication
3 = "run" indication (pull down when motor drives)
NOTICE ! fault input is disabled in setting 2 and 3
11- overvoltage limit: 15-60V / 15-60 (55)
Overvoltage can be caused by load driving the motor or when braking the speed down but supply can not accept the current back from driver. Exceeding the limit will cause the power stage set to free-wheel state.
With a direct battery supply the brake current is charging the battery and the voltage will not normally rise.
There is also 60V fixed dynamic brake point = motor pole shorted
12- load compensation: 0-255 / 0-255 (0)
Load compensation (Rxl) improves low speed and start torgue, but too high compensation achieve unstable running.
Run motor at low speed (30%) Increase compensation with small steps until motor start behaviour becomes unstable, then decrease value about 10%
13- timeout: 0-255s. / 0-255 (0=not in use) (0)
14- reset for start and hour-counter 0/1 (0)
selecting 1 and push SAVE -> reset counters
15- start ramp: 0-5s / 0-500 (50)
16- stop ramp: 0-5s / 0-500 (20)
17- start-kick 0-200ms / 0-200 (0)
This gives full drive at start and I-lim is 30A
The start kick length is 0-200ms.
18- Dead band wide 0-50% / 0-50 (5)
19- Freewheel options 0-3 (0)
0= no freewheel
1= freewheel when stopped
2= freewheel during stop ramp.
3= freewheel during stop ramp and if stopped
20- Pwm frequency 1=2kHz / 2=16kHz (1)
21- Brake output options (pin 16)
0= overvoltage activates output (brake resistor use)
1= output activates when motor run (magn. brake use)
2= output activates when motor runa and with stop input







JOYSTICK CALIBRATION

Give about 3s. control signal to CALIB input. when Fault-led of device will be lit:
(led is active only if parameter 10 is set to 1)
-push joystick full forward, then
-pull joystick full reverse, then
-release joystick to mid position, then
-wait until led starts to blink = calibration done

NOTICE ! calibration above defines joystick full fw, full rev. and mid point positions.
But the max. speed can be set with parameters 4 and 5

243c_fi04 24.8.2020

KNIGHT GLOBAL

KNIGHT GLOBAL
2705 Commerce Parkway
Auburn Hills, MI 48326
Phone: (248) 377-4950 | Fax: (248) 377-2135

For additional copies of the literature contact: salesorders@knightglobal.com
For technical questions contact: servos@knightglobal.com
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